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LOW CARBON FUELS: FOSSIL-FREE ALTERNATIVES

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Renewables are not the only way to power a net-zero carbon economy. Low carbon fuels have historically played an important, often unsung role in the energy transition and are positioned to quickly accelerate future decarbonization.

In part five of this six-part series, we expand on earlier discussion of the energy transition, energy efficiency and renewables and energy storage to look at opportunities for low carbon fuels.

Catalysts for change

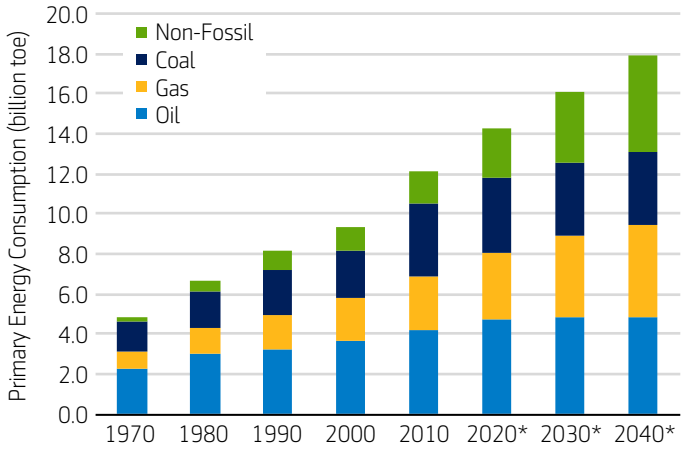
Low carbon fuels—a catch-all term for any low or zero greenhouse gas emission alternative for common fossil fuels—can be solid, liquid or gaseous fuels and are often grouped according to the traditional fuel they replace:

Gasoline	The most common substitute is ethanol, an alcohol made from plant sugars or cellulose, which has been in use since the days of the Ford Model T[1]. Another substitute is the more recent renewable gasoline, a drop-in equivalent to traditional gasoline refined from biomass feedstocks rather than crude oil.
Diesel	Traditional biodiesel, produced by the esterification of oils and fats. Additionally, there is the more modern renewable diesel, a drop-in equivalent to regular diesel, refined from waste and other residue or biomass materials rather than crude oil.
Natural gas	Renewable natural gas (RNG), sometimes known as green gas, biomethane or biogas, is methane produced from organic wastes and upgraded to pipeline-quality; and hydrogen, a fuel with no emissions when combusted and commonly produced via natural gas reforming or electrolysis of water.
Kerosene	Sustainable aviation fuel (SAF), or non-petroleum-based jet fuel.
Coal	Solid biomass such as wood pullets and similarly derived fuels that burn at high temperatures to replace coal.

Environmental and economic implications

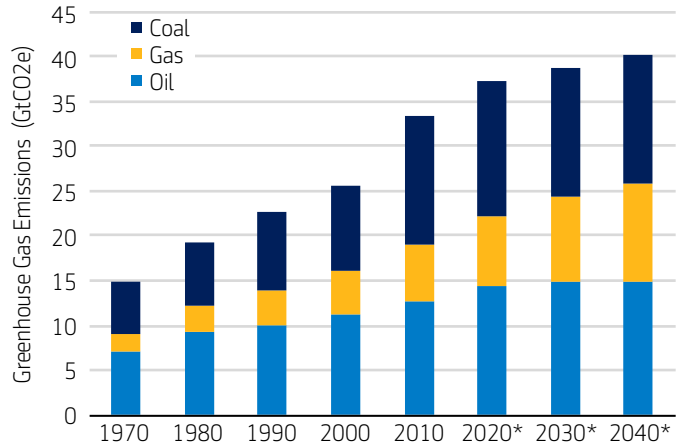
The annual demand for fossil fuels is massive (Exhibit 1A), as are the corresponding greenhouse gas emissions (Exhibit 1B). Fortunately, as more or less direct replacements, the potential market for low carbon fuels is equally as large but without the climate damaging pollution. Unlike renewables, these fuels do have emissions associated with their use; however, they are much better on a lifecycle basis (Exhibit 2), which measures the climate impact throughout the each step of the supply chain, from raw material and feedstock sourcing to end use combustion. Additionally, given the use of biomass feedstocks, often wastes and other byproducts, some low carbon fuels even have the possibility for negative emissions—meaning there is a possible net climate benefit from their use.

Exhibit 1A: Global primary energy demand by fuel type



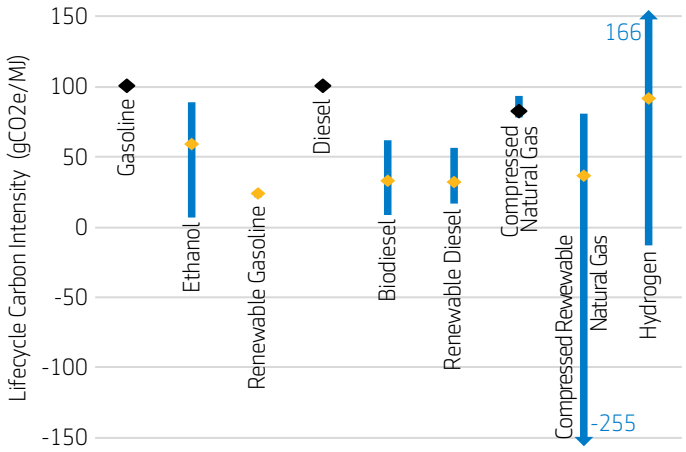
Source: BP as of 2019. *Projections.

Exhibit 1B: Global greenhouse gas emissions by fuel type



Source: BP as of 2019. *Projections.

Exhibit 2: Lifecycle emissions intensities for common transportation fuels



Source: California Air Resources Board. As of July 2020.

Industry disruption and investment opportunities

The use of low carbon fuels is often tied to regulatory requirements and incentives in addition to consumer demand for fossil fuels. There are straightforward volumetric requirements such as the US Renewable Fuel Standard[2], which sets specific amounts of fuel that must be blended for use, as well as outcome-based requirements such as the California Low Carbon Fuel Standard[3], which sets a greenhouse gas reduction target. As a result, the US Energy Information Administration expects the share of low carbon fuels blended into transportation fuels to grow from 7.3% in 2019 to 9% in 2040[4]. The same picture emerges globally, where the International Energy Agency estimates that annual production of low carbon fuels must grow some 5% to 22% per annum, more than doubled forecasted rates, by 2030 to meet the objectives of the Paris climate agreement[5].

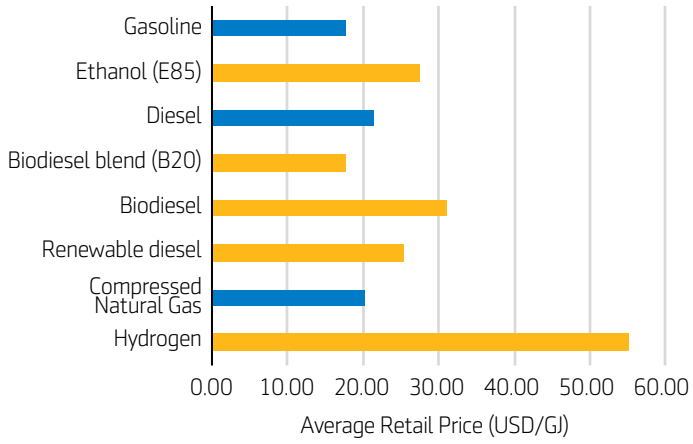
Traditionally the production and use of low carbon fuels has been protested by fossil fuel companies for obvious reasons: any increase forces a reduction in the sale of their primary products, and all associated regulation generally falls onto them for compliance. However, some companies have taken steps in an attempt to profit from these trends. For example, Canadian oil major Suncor owns and operates the country's largest ethanol facility[6] and Californian utility SoCalGas has begun to the preparations to necessary to begin offering renewable natural gas (RNG) to its customers[7]. At the same time, others are starting to see benefit in low carbon fuels outside of specific regulatory regimes and are making moves in response to their own view of the energy transition. One of the most recent and prominent examples was seen in early August 2020 when BP announced an expected increase in biofuel and hydrogen production in support of delivering on their net-zero ambition[8]. And in the aviation sector, European carriers such as KLM and Lufthansa are partnering with biofuel producers to increasingly offering customers the opportunity to use sustainable aviation fuel as a way to reduce the carbon impact of their flights[9,10].

Despite opportunities, challenges remain

There are three main barriers to greater use of low carbon fuels: cost, blending limitations and supply availability.

Apart from ethanol and biodiesel, most low carbon fuels are relatively new and don't benefit from the same economies of scale. Benchmarked against their fossil fuel equivalents—which themselves are not exactly inexpensive—fuel producers, distributors and consumers frequently have little economic incentive to switch to low carbon fuels without specific regulatory incentives (Exhibit 3).

Exhibit 3: Average US retail prices per unit energy for common transportation fuels



US Department of Energy. As of April 2020.

Blending limitations can also hinder the adoption of low carbon fuels. Sometimes referred to as a "blend wall," there are occasionally limits to the maximum amount of a low carbon alternative fuel that can be used or blended in the existing fuel supply before potentially causing damage to engines and other equipment. This limit varies greatly with the fuel in question. For example, renewable natural gas is able to replace 100% of fossil natural gas while ethanol can generally only be used in concentrations up 15% in standard, non-flex fuel passenger vehicles[11].

Finally, as with any new energy source, there are concerns of supply availability and the general availability of feedstocks. One study focused on the US identified that only about 420 billion cubic feet of renewable natural gas is potentially available from current sources[12], barely more than 1% of the over 31,000 billion cubic feet of natural gas used on an annual basis[13]. There is also an on-going "food vs. fuel" debate, specifically related to biofuels, where opponents argue that the use of crops to make biofuels is negatively influencing the price and availability of food; however these claims have largely not been backed by evidence from the likes of the United Nations Food and Agriculture Organization and the US Department of Agriculture, and the production of biofuels is estimated to have been a net positive to farmers[14,15].

Key themes and investment considerations

The climate crisis continues to present an urgent systemic risk. Low carbon fuels provide an option to quickly decarbonize existing activities either permanently to complement the spread of renewables—especially in so-called "hard to abate" sectors such as steel, cement or aviation where electrification is not a viable option—or temporarily while other zero-carbon technologies achieve scale (e.g., electric vehicles or heat pumps). To meet this demand, companies are expected to need capital to build supply chain capacity. For example, in 2018 US ethanol producer POET began construction of an 80 million-gallon-per-year facility in Indiana for an expected USD 160 million[16]. Companies may also need substantial investment to take their technologies to market. For example, in 2019 Canadian advanced-biofuel producer Enerkem closed a funding round worth CAD 76 million in support of the development of its waste-based biofuel projects in Quebec and the Netherlands[17].

Given their already high dependence on government regulation, green stimulus measures can also support the growth and adoption of low carbon fuels. Indeed, this has been the case historically as, for example, the US Renewable Fuel Standard was originally introduced in 2005 as part of an effort to address rising energy prices and growing dependence on oil imports[18]. Similarly, in July 2020 the EU introduced a hydrogen strategy to boost the use of the fuel to reduce greenhouse gas emissions and boost economic growth[19]. In the future, additional investment opportunities may arise as the regulatory environment continues to shift in favor of climate action and advancements in technology help accelerate the adoption of low carbon fuels.

Looking ahead

In the next edition of this series we will discuss carbon capture technology, including storage and utilization, as we conclude our exploration of the opportunities and challenges related to the energy transition.

Energy efficiency	Doing the same with less
Renewables	Generating energy without carbon emissions
Storage	Decoupling energy demand from generation
Low-carbon fuels	Using alternatives to common fossil fuels
Carbon capture	Capturing, storing and using carbon

References

[1]US Energy Information Administration "Biofuels explained - Use of ethanol" (24 June 2020) https://www.eia.gov/energyexplained/biofuels/use-of-ethanol.php

[2]US Environmental Protection Agency "Renewable Fuel Standard Program" (28 March 2019) https://www.epa.gov/renewable-fuel-standard-program

[3]California Air Resources Board "Low Carbon Fuel Standard" (accessed 5 August 2020) https://ww2.arb.ca.gov/our-work/programs/low-carbon-fuel-standard

[4]US Energy Information Administration "EIA projects U.S. biofuel production to slowly increase through 2050" Today in Energy (9 March 2020) https://www.eia.gov/todayinenergy/detail.php?id=43096#

[5]International Energy Agency (IEA) Transport Biofuels (June 2020) https://www.iea.org/reports/transport-biofuels

[6]Suncor "Biofuels" (accessed 5 August 2020) https://www.suncor.com/en-ca/about-us/biofuels

[7]Biomass Magazine "SoCalGas takes next step toward offering RNG" (21 April 2020) http://biomassmagazine.com/articles/16977/socalgas-takes-next-step-toward-offering-rng

[8]BP "From International Oil Company to Integrated Energy Company: bp sets out strategy for decade of delivery towards net zero ambition" (4 August 2020) https://www.bp.com/en/global/corporate/news-and-insights/press-releases/from-international-oil-company-to-integrated-energy-company-bp-sets-out-strategy-for-decade-of-delivery-towards-net-zero-ambition.html

[9]KLM Royal Dutch Airlines "KLM corporate Biofuel Programme" (accessed 1 September 2020) https://www.klm.com/travel/nl_en/prepare_for_travel/fly_co2_neutral/all_about_sustainable_travel/biofuel.htm

[10]Lufthansa Compensaid "Why fly with Sustainable Aviation Fuel?" (accessed 1 September 2020) https://lufthansa.compensaid.com/projects/saf

[11]US Environmental Protection Agency "Ethanol Waivers (E15 and E10)" (25 October 2019) https://www.epa.gov/gasoline-standards/ethanol-waivers-e15-and-e10

[12]National Renewable Energy Laboratory (NREL) Energy Analysis Biogas Potential in the United States (October 2013) https://www.nrel.gov/docs/fy14osti/60178.pdf

[13]US Energy Information Administration "Natural Gas Summary – Annual 2019" (31 July 2020) https://www.eia.gov/dnav/ng/ng_sum_lsum_dcu_nus_a.htm

[14]Minnesota Bio-Fuels Association "Food vs Fuel" (accessed 5 August 2020) https://www.mnbiofuels.org/resources/facts-about-ethanol/food-versus-fuel

[15]Desplechin, Emmanuel "Five things you need to know about the 'food vs fuel' debate" (30 March 2017) https://www.politico.eu/sponsored-content/five-things-you-need-to-know-about-the-food-vs-fuel-debate/

[16]POET "POET Begins Construction on New Facility in Shelbyville, Indiana" (26 October 2018) https://poet.com/pr/new-biofuel-facility-shelbyville-indiana

[17]Enerkem "Enerkem closes a new round of financing for $76.3 M" (16 April 2019) https://enerkem.com/newsroom/releases/?communique_id=122571

[18]EveryCRSReport.com "Energy Policy Act of 2005: Summary and Analysis of Enacted Provisions" (8 March 2006) https://www.everycrsreport.com/reports/RL33302.html

[19]European Commission "Factsheet - EU Hydrogen Strategy" (8 July 2020) https://ec.europa.eu/commission/presscorner/detail/en/FS_20_1296

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